

## Multiple Cocoon Crops module and its impact on Stabilization of Autumn Crop under Subtropical condition of North West India

### Abstract

The limited number of cocoon crops is observed as a challenge for the economic viability of the sericulture industry in North- Western India. The present study was conducted mainly to explore the possibility of multiple cocoon crops in North West India and expected that introduction of the additional crops in between spring and the autumn will force the pruning of mulberry trees before the autumn crop hence, it will help in productivity improvement during the autumn crop. A diagnostic study was conducted in 2018 to study the brushing dates and pruning schedule for three cocoon crops and an assessment was made for impact on autumn crop through the introduction of summer crops in between the spring & the autumn crops. Finally, silkworm hybrids FC<sub>1</sub>×FC<sub>2</sub> & SH<sub>6</sub>×NB<sub>4</sub>D<sub>2</sub> was shortlisted for field trial of spring, summer and autumn season (2020) respectively from the evaluated hybrids during previous studies (2018 & 2019) at the Regional Sericultural Research Station, Jammu (RSRS). The field trial was conducted with 9 selected readers sponsored by Department of Sericulture, J&K & Himachal Pradesh and laboratory rearing was conducted at RSRS, Jammu. Three crop rearing schedule was followed with an innovative approach for date of brushing, leaf harvesting, silkworm rearing & mounting of larvae. The outcome of the study leads to understanding that change in brushing dates, rearing with shortlisted silkworm hybrids and use of improved rearing & mounting techniques can improve the cocoon productivity/100 DFLs in one hand and introduction of Summer crop in between spring & autumn crop can also improve the cocoon yield during the autumn crop. Farmer's level study revealed that an average yield recorded during spring crop of about **70.67 Kg & 60.33 Kg/100 DFLs** in Jammu & HP whereas lab rearing at RSRS, Jammu recorded about **83.00 Kg/100 DFLs**. The average yield during summer crop was of about **44.40 Kg & 35.35 Kg/100 DFLs** in Jammu & HP and lab rearing at RSRS, Jammu recorded about **51.87 Kg/100 DFLs** respectively. During autumn crop an average yield of about **40.80 Kg & 43.67 Kg/100 DFLs** was recorded at Jammu & HP and lab rearing at RSRS, Jammu recorded about **44.75 Kg/100 DFLs**. The impact of the introduction by summer crop revealed that *per cent* yield gain over traditional field rearing from experimental field trials about **67.14 (%)** and **44.70 (%)** yield gain records in the autumn season at Jammu division and Himachal Pradesh respectively.

**Key words:** *Multiple cocoon crops, Spring, Summer, Autumn, Jammu, Himachal Pradesh, Cocoon Yield*

### Introduction

One crop success story and the subsidiary nature of silk cocoon crops is a major limiting factor for sericulture development in North Western India. Though efforts were made but except spring crop no other silk cocoon crop could be stabilized at the farmer level. Isolated efforts were

made at the farm and farmer level but so far have not yielded desired results. Sericulture activities in the North-Western region of India are depending upon two crops- spring and autumn only, of which autumn crop is yet to be stabilized at farmer's level as a result about 75-80 (%) of the cocoon are being produced from spring crops only.

Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Punjab and Haryana constitutes the North Western sericulture zone of the country and are known for exclusively bivoltine cocoon production, no doubt it has salubrious good climatic condition during the spring rearing season for production of high quality bivoltine cocoons and there are very few pockets in the country which may be considered as a natural home for bivoltine silk. However, it has certain limitations also. Only spring crop has the climatic advantages, Henceover decades, the entire zones depends on this crop for its annual raw silk output. There are only two silk cocoon crops in vogue in this zone *i.e.* spring and autumn of which spring crop alone constitutes about 80 per cent (except Uttarakhand) of the annual cocoon production (Singh and Murali, 2019).

The most important debated issue for the development of sericulture in North-West India is - can the number of silk cocoon crops will be increased, why the autumn crop is not stabilized at the farmer level and whether is there a scope for a third crop introduction between spring and autumn. It is evident from the recent cocoon production trends in the major cocoon producing states of North-West India (Anonymous, 2017a). During the year 2016-17 Jammu and Kashmir is the largest cocoon producing state of North-West India with a production of about produced 973.30 MT of a bivoltine cocoon of which only 25.95 MT (2.66%) were produced during autumn crop (Anonymous, 2017b). Similarly in Himachal Pradesh the second largest cocoon producing state in the region, cocoon production during 2016-17 produced 236.55 MT of which only 35.40 (18%) were produced during the autumn crop (Anonymous, 2017c). Condition is slightly better in Uttarakhand which produced 231.37 MT of the cocoon of which 98.13 MT (42.41%) were produced during the autumn crop. Yield /100 dfls during spring crop in J& K during 2016-17 was 39.41 Kg while during autumn it was only 26.95 Kg while in Himachal Pradesh it was 41.01 Kg during spring and 26 Kg during autumn (Anonymous, 2017d). The aim of the study was mainly to explore the possibility of multiple cocoon crops in North West India and expected that introduction of a crop in between spring and the autumn will force the pruning of mulberry trees before the autumn crop hence, it will help in stabilization of autumn crops. Based on the study, the brushing dates and pruning schedule based on three cocoon crops was worked out and an assessment was made for impact on the autumn crop through the introduction of summer crops in between the spring & autumn crop.

## Material and Methods

A preliminary work-study in 2018, followed by was conducted at institute level investigation in 2019 was conducted to select suitable brushing dates for spring, summer and autumn crops and the suitable hybrid combination was shortlisted for all three crops using the Mano index. The field trial were conducted by adopting three crops schedule with shortlisted hybrids were conducted with the farmers sponsored by the Department of Sericulture (DOS) in two states under a given location covering 5 potential sericulture districts of North West India. Spring, Summer and autumn crop was conducted with shortlisted hybrid *i.e.* FC<sub>1</sub>×FC<sub>2</sub> for spring crop & SH<sub>6</sub>×NB<sub>4</sub>D<sub>2</sub> for summer & autumn crop respectively with new brushing date at Jammu and Himachal region with selected silkworm rearers at each location with actual rearing capacity of the farmers. Chawki reared worms were distributed and leave were used from the same trees for the three different seasons by adopting pruning from time to time (Table 1).

**Table 1. Showing pruning and brushing schedule adopted during different seasons of the study**

Season	Pruning schedule	Brushing schedule	
		Jammu Condition (J&K)	H.P
Spring	Shoot harvesting for <b>late age rearing during spring crop</b> leaving behind a shoot bearing leaf on each branch.	Early first week of March (1 <sup>st</sup> of March)	Early 2 <sup>nd</sup> week of March (5 <sup>th</sup> -10 <sup>th</sup> March)
Summer	Shoot let harvesting for <b>late age rearing during summer crop</b> (June - July) adopting recommended method of monsoon pruning <b>this will force</b> the adoption of pruning practice in between spring and autumn crops which is absent at present and a pre-requisite for <b>the success of the autumn crop.</b>	3 <sup>rd</sup> week of June (Between 15-30 <sup>th</sup> of June)	2 <sup>nd</sup> week of June (10-15 <sup>th</sup> of June)
Autumn	Apical harvesting of primary branches (above 3 feet crown on <b>the main branch</b> ) during <b>the autumn crop.</b>	10-15 <sup>th</sup> of September	1 <sup>st</sup> week of September

## Methodology

Farmer's level (DOS sponsored farmers in potential sericulture districts) rearing was conducted with proven technology and innovative approach, based on the outcome of experimental rearing conducted at RSRS, Miran Sahib, Jammu during previous years (2018 & 2019). Spring, summer and autumn field rearing was conducted during 2020 among DOS sponsored farmers (9 Nos) with shortlisted hybrid *i.e.* FC<sub>1</sub>×FC<sub>2</sub> for spring crop & SH<sub>6</sub>×NB<sub>4</sub>D<sub>2</sub> for summer & autumn crop respectively (based on actual rearing capacity of the farmer) with overall technical and material support through RSRS, Jammu/State Sericulture Departments (DOSs) and Research Extension Centers (RECs) of CSB at **the identified location.** DOS, J&K

and DOS, HP sponsored three and six farmers respectively, thus total 9 farmers with the help of the State Department of Sericulture/ Research Extension Centers of CSB in three different locations of representative sericulture districts in Jammu province of Jammu & Kashmir and Himachal Pradesh where finally identified. Accordingly farmer level rearing during spring, summer and autumn crop in J&K and HP was conducted with five potential sericulture districts - Rajouri, Udhampur&Kathua in J&K and district Bilaspur and Kangra in Himachal Pradesh comprising 03 farmers from each location having rearing capacity up to 50 dfls/farmer &Control rearing (50 DFLs) for the shortlisted hybrid was conducted at RSRS, Miran Sahib, Jammu to assess research level yield and potential yield at rearer's level. The introduction of summer crop in between spring and autumn was studied and its impact on the autumn crop was analyzed. The hybrid seed was procured from SSPC, Prem Nagar, Dehradun and were incubated at RSRS, Jammu and REC, Ghumarwin (H.P) worms were distributed after second moult for each selected rearers.

## Results and Discussion

The results of the field trial investigation at Jammu (J&K) and Himachal Pradesh with DOS sponsored rearers during spring, summer and autumn (2020) seasons were presented here under:

From the present study, the results observedrevealed that during spring rearing when brushing was done on 01.03.2020 and the chawki reared worms were distributed to each location on 10.03.2020 having 50 DFLs per rearer. In the Jammu region of J&K cocoon yield is varied ranging from 58 Kg to 78Kg /100 dfls. The Actual yield recorded was about 76, 78 and 58 Kg/100 DFLs for at Lamberi (Rajouri Dist.), Majalta (Udhampur Dist.) and Dharamakot (Kathua Dist.) regions respectively at Jammu division and the average yield was recorded as **70.67 Kg/100 DFLs** whereas in at Himachal Pradesh cocoon yield was in range recorded from 36 to 74 Kg/100 dfls having an actual yield of about 71, 36 and 74 Kg/100 DFLs for at Soi, Panol and Naswal region of Bilaspur Dist., Himachal Pradesh and average yield was about**60.33 Kg/100 DFLs**. The control batch reared at RSRS, Jammu under laboratory conditions achieved recorded yield was about **83 Kg/100 DFLs**(Table 2). The filament length was recorded about 974.00 mtrs, denier (2.59), Renditta (2.14), Reelability (84.45%), Raw silk (32.11%) and Neatness (95.00) at farmers level whereas at control batch rearing, filament length was recorded about 855.00 mtrs, denier (2.34), Renditta (2.83), Reelability (74.86%), Raw silk (35.72%) and Neatness (90.00) respectively for the trial conducted during Spring season (2020) (Table 3).

SH<sub>6</sub>×NB<sub>4</sub>D<sub>2</sub> was shortlisted for the summer season from the evaluated hybrids during previous studyyears (2018 & 2019) and brushed on 29.06.2020 and 28.06.2020 at Jammu &Ghumarwin(H.P) respectively. The chawki reared worms were distributed to each location on 12.07.2020 (Lamberi, Rajouri Dist.), 13.07.2020 (Dharmakot, Kathua Dist.) and 14.07.2020 (Majalta, Udhampur Dist.) in Jammu division whereas Bilaspur region (H.P) worms were distributed on 07.07.2020 having 50 DFLs per rearer. The yield recorded was about 44, 44 and

45.20 Kg/100 DFLs for at Lamberi (Rajouri Dist.), Majalta (Udhampur Dist.) and Dharamkot (Kathua Dist.) regions respectively with average yield of about **44.40 Kg/100 DFLs** at Jammu division whereas 17, 16.67 and 14.60 Kg/100 DFLs for Soi, Panol and Naswal region of Bilaspur Dist., Himachal Pradesh and 42.60, 74.40, 46.80 Kg/100 DFLs at for Sanot region (3 rearers) of Kangra Dist. Himachal Pradesh with an average yield of about **35.35 Kg/100 DFLs** was recorded. The control batch reared at RSRS, Jammu recorded a yield was about **51.87 Kg/100 DFLs** (Table 4). The farmers conducting silkworm rearing in the summer season harvest mulberry leaves bloomed after the spring crop harvest.

The result of the present study is in accordance with the results observed obtained at North Kashmir during the summer season (2006) (Farooq *et al.*, 2007). Further, at the time of the implementation of the cluster development program in Kashmir valley, summer crops were also undertaken in Tral and Bandipora clusters. The results obtained from cluster silkworm rearers were better (Aslam *et al.*, 2016) than the results obtained in North Kashmir (Farooq *et al.*, 2007). A comparative study with 33 cluster and 30 non cluster silkworm rearers was conducted in the Tral area during the summer season (2015) and it was observed revealed that the cluster farmers who have adequate infrastructure have harvested with an average cocoon yield of 33.72 Kg/100 DFLs whereas non cluster farmers have harvested 7.95 Kg/100 DFLs in the same area (Aslam *et al.*, 2016). The reasons behind the better results of cluster farmers may be the infrastructure developed under the programme and helped them to adopt the technologies as per the recommended package of practices (Aslam *et al.*, 2016).

Similar results were in agreement with Singh and Singh (2012) reported observed that a successful trial of summer crop was conducted in Himachal Pradesh where 2000 dfls of PM×CSR2 was reared at farmer's level and an average yield of about 45 Kg/100 dfls was obtained during July 2010, where organized mulberry plantation was developed in 2006 were used utilized for silkworm rearing.

Similarly, a diagnostic study was conducted at Regional Sericultural Research Station Jammu in 2018 to explore the possible possibility of introduction of a third crop in between spring and autumn with a selection of suitable hybrid and brushing date for summer rearing under the sub-tropical condition of Jammu. The hybrid selection was made after evaluating the pool of silkworm the hybrid developed at different institutes. Brushing was ascertained after brushing the silkworm eggs at different dates and hybrids were evaluated according to the evaluation index for desired economic parameters for both quantity and quality based on evaluation index developed by Mano *et al.* (1993). Hybrids showing an index value above 50 were shortlisted. The first brushing was conducted on 10<sup>th</sup> of June 2018 with eight hybrids and the shortlisted hybrids were ~~are~~ FC<sub>1</sub>×FC<sub>2</sub>, D×O<sub>2</sub>, D×O<sub>3</sub> and SH<sub>6</sub>×NB<sub>4</sub>D<sub>2</sub> whereas Nine hybrids were was reared during the second brushing of the summer season (2018), brushed on 25.06.2018. The hybrids showing an index value above 50 were shortlisted as PM×FC<sub>2</sub>, PM×CSR2, SH<sub>6</sub>×NB<sub>4</sub>D<sub>2</sub>, SK<sub>6</sub>×SK<sub>7</sub> and D×O<sub>3</sub>. Based on the study promising silkworm hybrid

and suitable date of brushing for **the** introduction of additional summer crop under sub-tropical condition has been worked out by Singh and Murali (2019).

From **the** present study investigation, the post cocoon parameters data observed revealed **that** the average filament length was recorded **as** about 725.33 mtrs, denier (2.54), Renditta (3.44), Reelability (75.48%), Raw silk (29.46%) and Neatness (89.67) at Jammu division whereas at Himachal Pradesh the average filament length was recorded about 752.00 mtrs, denier (2.26), Renditta (3.66), Reelability (69.81%), Raw silk (27.72%) and Neatness (94.67) respectively for the field trial conducted during Summer season (2020) and the control batch rearing at RSRS, Jammu the filament length was recorded about 825.00 mtrs, denier (2.62), Renditta (2.95), Reelability (78.27%), Raw silk (34.12%) and Neatness (93.00) (Table 5). The results were in accordance with summer rearing conducted at RSRS, Jammu (2018), the post cocoon parameters data reveals observed that, the filament length was highest in  $FC_1 \times FC_2$  (979 mtrs) and lowest was recorded in  $SK_6 \times SK_7$  (461.00 mtrs) whereas reelability was maximum in  $D \times O_3$  (87.00%) and lowest in  $SK_6 \times SK_7$  (66.00%). The renditta on dry cocoon was recorded lowest in  $FC_1 \times FC_2$  (2.65) and maximum was recorded in  $D \times O_3$  (3.68) whereas neatness was recorded highest in  $FC_1 \times FC_2$  (98.00%) and lowest was recorded in  $D \times O_2$  and  $B.con\ 1 \times B.con\ 4$  (93.00%). The raw silk *per cent* was maximum in  $FC_1 \times FC_2$  (38.10%) and lowest was recorded in  $D \times O_3$  (27.46%) (Singh and Murali, 2019).

During **the** autumn season field trial,  $SH_6 \times NB_4 D_2$  was shortlisted from the evaluated hybrids during previous study seasons (2018 & 2019) and brushed on 08.09.2020 and 06.09.2020 at Jammu & Ghumarwin respectively. The chawki reared worms were distributed to each location on 17.09.2020 (Lamberi, Rajouri Dist. & Majalta, Udhampur Dist.) and 16.09.2020 (Dharamkot, Kathua Dist.) at Jammu division whereas Bilaspur region (H.P) worms were distributed on 15.09.2020 having 50 DFLs (20000 worms) per rearer. The yield recorded was about 41, 37 and 44.40 Kg/100 DFLs at for Lamberi (Rajouri Dist.), Majalta (Udhampur Dist.) and Dharmakot region (Kathua Dist.) respectively at Jammu division and having average yield about **40.80 Kg/100 DFLs** whereas 46.70, 47.90 and 47.40 Kg/100 DFLs at for Soi, Panol and Naswal region of Bilaspur, Himachal Pradesh and 39.50, 39.80, 40.70 Kg/100 DFLs at for Sanot region (3 rearers) of Kangra dist., Himachal Pradesh with **an** average yield of about **43.67 Kg/100 DFLs** was recorded for Himachal Pradesh. The control batch reared at RSRS, Jammu recorded **a** yield was about **44.75 Kg/100 DFLs** (Table 6). The average filament length was recorded about 768.67 mtrs, denier (2.40), Renditta (3.01), Reelability (76.28%), Raw silk (27.31%) and Neatness (94.33) at Jammu division whereas Himachal Pradesh the average filament length was recorded about 775.33 mtrs, denier (2.35), Renditta (3.42), Reelability (73.28%), Raw silk (25.96%) and Neatness (95.33) respectively for the field trial conducted during **the** autumn season (2020) and the **controlled** rearing at RSRS, Jammu the filament length was recorded about 879.00 mtrs, denier (2.62), Renditta (3.15), Reelability (88.38%), Raw silk (33.26%) and Neatness (93.00) (Table 7).

A new date of brushing has been assessed which suggests that the Spring crop in the region needs to be preponed by a week over the traditional date(s), Summer crop can be conducted in the month of June between the 2<sup>nd</sup> to 4<sup>th</sup> week and the autumn crop to be postponed by a week over the traditional date of brushing especially in two major sericulture states *i.e.* Jammu region (Sub tropical) of J & K and Himachal Pradesh respectively (Singh and Murali, 2019).

### **Impact on autumn crop by introduction of summer crop**

Measured in terms of *per cent* gain over existing practices after diffusions of knowledge & innovation and introduction of summer crop in between spring & autumn crop.

The average yield recorded by rearers at in the Jammu division of J&K during the autumn season was at about 40.80 Kg and HP was recorded about 43.67 Kg/100 dfls respectively. The *per cent* yield gain over traditional field rearing from experimental field trials revealed that **67.14 (%)** and **44.70 (%)** gain records in the autumn season at Jammu division and Himachal Pradesh in the same area respectively (Table 8).

The summer crop is completed in the month of July last and fresh leaf is available for the next autumn crop after harvesting the leaf during summer rearing, it was a sort of forced pruning which otherwise is not done before the autumn crop. This had helps in the improvement of autumn silkworm crop performance and those farmers who are not opting for mulberry pruning after spring crops should take summer crop and sericulture becomes more remunerative.

**Conclusion:** The findings of the study lead to understand the performance & evaluation of ruling new bivoltine & ICB hybrids under the rearing conditions of North West India, especially at RSRS, Jammu a hotspot for hybrid evaluation in North India. Hybrid evaluation and short listing of hybrids procured from different R&D institutes of CSB for multiple cocoon crops (Spring, Summer and Autumn) has been done the first time and evaluated hybrids can be utilized for future rearing programs by DOSs of the region.

A crop is possible between traditional spring and autumn crop in the form of summer crop and thus three crop schedules has been workout instead of two. Summer crop has a positive impact on the autumn crop because of pruning was adopted/forced before the autumn crop to improve mulberry leaf quality. Pruning and harvesting technology as advocated by the institute is also got validated. Overall knowledge & outcome has been shared through virtual mode & in the form of PPT among officers and field functionaries of DOS J&K, Himachal Pradesh and Punjab.

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## References:

1. Anonymous (2017a). Issues/ challenges and way forward – interaction with scientists and technical personnel R & D intervention in pre-cocoon sector. National Level Interaction Meeting with the Stake Holders of Silk Industry, 10<sup>th</sup> Feb, 2017, Constitution Club of India, New Delhi. pp. 5.
2. Anonymous (2017b). Meeting of Joint State Level Sericulture Coordination Committee of HP, Punjab and Haryana states held on 23<sup>rd</sup> August, 2017 at Secretariat, Conference hall, Armsdale building, Shimla. pp. 5-6.
3. Anonymous (2017c). Agenda and explanatory notes for the Meeting of J & K State Level Sericulture Coordination Committee (JKSLSCC) held on 27<sup>th</sup> April, 2017 at Jammu. pp. 9-10.
4. Anonymous (2017d). Meeting of Uttarakhand State Level Sericulture Coordination Committee (UKSLSCC) held on 27<sup>th</sup> April, 2017 at Jammu. pp. 6-7.
5. Aslam, M., Ahmad, M.N., Rashid, H., Dhar, A., Khan, M.A. and Sahaf, K.A. (2016). Feasibility of summer crop in Kashmir valley. *Indian Horticulture Journal*, 6:71-73.
6. Farooq, M., Singh, T.P., Noorud-Din, S., Rufaie, Z.H., Bacqual, M.F. and Dar, H.U. (2007). Second commercial crop to make sericulture a more profitable venture in Kashmir: Regional seminar on Prospect and Problems of Sericulture as an Economic Enterprise in North West India, 275-276.
7. Mano, Y., Kumar, N.S., Basavaraju, H.K., Mal Reddy, N. and Datta, R. K. (1993). A new method to select the promising silkworm breeds / combinations. *Indian silk*, 13, pp.5.
8. Singh, S. and Murali, S. (2019). Evaluation of selected hybrids during summer and ascertain brushing dates for introduction of additional cocoon crop under subtropical condition of Jammu (J & K). *International Journal of Chemical Studies*, 7(6): 448-453.
9. Singh, S. and Singh, R. D. (2012). Technical Compendium on Cluster Project for Mulberry Sericulture in HP Implementation, Outcome and Handing Over. 2012, 27- 28.

**Table 2. Average Data Recorded during Spring Field trial for the Hybrid, FC<sub>1</sub>×FC<sub>2</sub> through Shelf Rearing (2020) at different places of Jammu & Himachal Pradesh and Control rearing at RSRS, Jammu**

Name of Location	Date of incubation	Date of brushing	H (%)	Date of distribution	Wt. of 10 Mature Larvae (g.)	5th Instar Larval Period (D:H)	Total Larval Period (D:H)	Actual Yield (Kg)	Av. Yield / 100 DFLs	SCW (g)	SSW (g)	SR (%)
<b>Jammu Division (J&amp;K)</b>												
Lamberi, (Rajouri)	21.02.2020	01.03.2020	94.33	10.03.2020	55.00	6.00	29.00	38.00	76.00	1.90	0.40	21.04

Majalta, (Udhampur)	21.02.2020	01.03.2020	94.33	10.03.2020	56.00	6.19	31.00	39.00	78.00	1.763	0.393	22.29
Dharamkot, (Kathua)	21.02.2020	01.03.2020	94.33	10.03.2020	58.00	8.02	29.12	29.00	58.00	1.70	0.348	20.47
<b>Avg.</b>			<b>94.33</b>		<b>56.33</b>	<b>6.23</b>	<b>29.20</b>	<b>35.33</b>	<b>70.67</b>	<b>1.79</b>	<b>0.38</b>	<b>21.27</b>
<b>Himachal Pradesh</b>												
Soi (Bilaspur)	21.02.2020	01.03.2020	90.00	10.03.2020	54.00	10.08	32.04	35.50	71.00	1.81	0.40	22.09
Panol (Bilaspur)	21.02.2020	01.03.2020	90.00	10.03.2020	50.00	10.08	32.04	18.00	36.00	1.80	0.39	21.66
Naswal (Bilaspur)	21.02.2020	01.03.2020	90.00	10.03.2020	56.00	10.08	32.04	37.00	74.00	1.81	0.40	22.09
<b>Avg.</b>			<b>90.00</b>		<b>53.33</b>	<b>10.08</b>	<b>32.04</b>	<b>30.17</b>	<b>60.33</b>	<b>1.81</b>	<b>0.40</b>	<b>21.95</b>
<b>Control Rearing (Lab condition)</b>												
RSRS, Jammu	21.02.2020	01.03.2020	94.33	10.03.2020	52.00	7.16	27.03	41.50	83.00	1.84	0.38	20.28
<b>Avg.</b>			<b>94.33</b>		<b>52.00</b>	<b>7.16</b>	<b>27.03</b>	<b>41.50</b>	<b>83.00</b>	<b>1.84</b>	<b>0.38</b>	<b>20.28</b>

Note: No. of DFLs distributed: 50 DFLs; No. of Farmers covered: 9; H-Hatching

**Table 3. Showing post cocoon parameters (Dry cocoon) recorded for FC<sub>1</sub>×FC<sub>2</sub> (2020) trial rearing during spring (2020) at Field and Control batch at RSRS, Miran Sahib, Jammu**

Location	AFL (mtr)	Deneir	Renditta	Reelability (%)	Raw Silk (%)	Neatness
<b>Jammu Division</b>						
Farmers level	974.00	2.59	2.14	84.45	32.11	95.00
<b>Control batch rearing</b>						
RSRS, Jammu	855.00	2.34	2.83	74.86	35.72	90.00
<b>Avg.</b>	<b>914.50</b>	<b>2.47</b>	<b>2.49</b>	<b>79.66</b>	<b>33.92</b>	<b>92.50</b>
<b>SD±</b>	<b>84.15</b>	<b>0.18</b>	<b>0.49</b>	<b>6.78</b>	<b>2.55</b>	<b>3.54</b>

Note: AFL – Average filament length; SD-standard deviation

**Table 4. Average Data Recorded during Summer Field trial for the Hybrid, SH<sub>6</sub>×NB<sub>4</sub>D<sub>2</sub> through Shelf Rearing (2020) at different places of Jammu & Himachal Pradesh and Control batch at RSRS, Jammu**

Name of location	Date of incubation	Date of brushing	H (%)	Date of distribution	Wt. of 10 Mature Larvae (g.)	5 <sup>th</sup> Instar Larval Period (D:H)	Total Larval Period (D:H)	Actual Yield (kg)	Av. Yield / 100 DFLs	SCW (g)	SSW (g)	SR (%)
<b>Jammu Division (J &amp; K)</b>												
Lamberi, (Rajouri)	26.06.2020	29.06.2020	91.80	07.07.2020	45.03	7:00	24:00	22.00	44.00	1.819	0.351	19.29
Ramkot, (Udhampur)	26.06.2020	29.06.2020	91.80	07.07.2020	45.00	7:04	24:00	22.00	44.00	1.560	0.310	19.24
Barnoti, (Kathua)	26.06.2020	29.06.2020	90.00	07.07.2020	44.00	7:02	26:00	22.60	45.20	1.600	0.300	18.75
<b>Avg.</b>			<b>91.20</b>		<b>44.68</b>	<b>7:02</b>	<b>24:16</b>	<b>22.20</b>	<b>44.40</b>	<b>1.66</b>	<b>0.32</b>	<b>19.09</b>
<b>Himachal Pradesh</b>												
Soi (Bilaspur)	25.06.2020	28.06.2020	90.00	07.07.2020	40.00	7:10	27:00	8.50	17.00	1.570	0.270	17.20
Panol (Bilaspur)	25.06.2020	28.06.2020	90.00	07.07.2020	38.00	7:10	27:00	8.34	16.67	1.580	0.270	17.15

Naswal (Bilaspur)	25.06.2020	28.06.2020	90.00	07.07.2020	36.00	7:10	27:00	7.30	14.60	1.560	0.260	17.05
Sanot (Kangra)	27.06.2020	30.06.2020	95.00	09.07.2020	56.00	7:10	26:10	21.30	42.60	1.92	0.350	18.23
Sanot (Kangra)	27.06.2020	30.06.2020	95.00	09.07.2020	60.00	7:13	26:08	18.60	74.40	1.88	0.340	18.08
Sanot (Kangra)	27.06.2020	30.06.2020	95.00	09.07.2020	58.00	7:12	26:11	11.70	46.80	1.72	0.310	18.02
<b>Avg.</b>			<b>92.50</b>		<b>48.00</b>	<b>7:11</b>	<b>26:17</b>	<b>12.62</b>	<b>35.35</b>	<b>1.71</b>	<b>0.30</b>	<b>17.62</b>
<b>RSRS Jammu (Control Batch)</b>												
RSRS, Jammu	26.06.2020	29.06.2020	91.80	-	55.00	5:20	23:03	25.93	51.87	1.650	0.315	19.02
<b>Avg.</b>			<b>91.80</b>		<b>55.00</b>	<b>5:20</b>	<b>23:03</b>	<b>25.93</b>	<b>51.87</b>	<b>1.650</b>	<b>0.315</b>	<b>19.02</b>

Note: No. of DFLs distributed: 50 DFLs; No. of Farmers covered: 9; H-Hatching

**Table 5. Showing post cocoon parameters (Dry cocoon) recorded for summer (2020) trial rearing at Field and Control batch at RSRS, Miran Sahib, Jammu**

Location	AFL (mtr)	Deneir	Renditta	Reelability (%)	Raw Silk (%)	Neatness
<b>Jammu division</b>						
Lamberi (Rajouri)	639.00	2.38	3.45	75.98	29.16	93.00
Majalta (Udhampur)	849.00	2.73	3.15	72.61	32.07	93.00
Dharamakot (Kathua)	688.00	2.52	3.73	77.85	27.14	83.00
<b>Avg.</b>	<b>725.33</b>	<b>2.54</b>	<b>3.44</b>	<b>75.48</b>	<b>29.46</b>	<b>89.67</b>
<b>Himachal Pradesh</b>						
Soi (Bilaspur)	772.00	2.31	3.33	70.55	30.23	93.00
Panol (Bilaspur)	735.00	2.29	3.84	67.83	26.50	93.00
Naswal (Bilaspur)	749.00	2.18	3.82	71.04	26.43	98.00
<b>Avg.</b>	<b>752.00</b>	<b>2.26</b>	<b>3.66</b>	<b>69.81</b>	<b>27.72</b>	<b>94.67</b>
<b>Control batch rearing</b>						
RSRS, Jammu	825.00	2.62	2.95	78.27	34.12	93.00
<b>Overall Avg.</b>	<b>751.00</b>	<b>2.43</b>	<b>3.47</b>	<b>73.45</b>	<b>29.38</b>	<b>92.29</b>
<b>SD±</b>	<b>73.36</b>	<b>0.20</b>	<b>0.35</b>	<b>3.99</b>	<b>2.96</b>	<b>4.50</b>

Note: AFL – Average filament length; SD-standard deviation

**Table 6. Average Data Recorded during Autumn Field trial for the Hybrid, SH<sub>6</sub>×NB<sub>4</sub>D<sub>2</sub> through Shelf Rearing (2020) at different places of Jammu & Himachal Pradesh and Control batch at RSRS, Jammu**

Name of location	Date of incubation	Date of brushing	H (%)	Date of distribution	Wt. of 10 Mature Larvae (g.)	5 <sup>th</sup> Instar Larval Period (D:H)	Total Larval Period (D:H)	Actual Yield (kg)	Av. Yield / 100 DFLs	SCW (g)	SSW (g)	SR (%)
<b>Jammu Division (J &amp; K)</b>												
Lamberi, (Rajouri)	31.08.2020	08.09.2020	88.91	17.09.2020	42.00	7:02	25:05	20.500	41.00	1.729	0.342	19.80
Majalta (Udhampur)	31.08.2020	08.09.2020	88.91	17.09.2020	42.00	8:21	24:00	18.500	37.00	1.513	0.265	17.51
Dharmakot (Kathua)	31.08.2020	08.09.2020	88.91	16.09.2020	43.00	8:06	28:03	22.200	44.40	1.620	0.290	17.90
<b>Avg.</b>			<b>88.91</b>		<b>42.33</b>	<b>8:02</b>	<b>25:19</b>	<b>20.40</b>	<b>40.80</b>	<b>1.62</b>	<b>0.30</b>	<b>18.40</b>
<b>Himachal Pradesh</b>												

Soi (Bilaspur)	31.08.2020	06.09.2020	90.00	15.09.2020	47.00	7:22	24:04	23.350	46.70	1.75	0.315	18.00
Panol (Bilaspur)	31.08.2020	06.09.2020	90.00	15.09.2020	46.00	9:22	26:04	23.950	47.90	1.80	0.325	18.06
Naswal (Bilaspur)	31.08.2020	06.09.2020	90.00	15.09.2020	47.00	8:22	25:04	23.700	47.40	1.80	0.324	18.00
Sanot (Kangra)	31.08.2020	07.09.2020	90.00	17.09.2020	-	8:00	26:00	19.75	39.50	1.68	0.30	17.86
Sanot (Kangra)	31.08.2020	07.09.2020	90.00	17.09.2020	-	8:00	26:00	19.90	39.80	1.70	0.30	17.94
Sanot (Kangra)	31.08.2020	07.09.2020	90.00	17.09.2020	-	8:00	26:00	20.35	40.70	1.72	0.31	18.02
Avg.			<b>90.00</b>		<b>46.67</b>	<b>8:11</b>	<b>25:14</b>	<b>21.83</b>	<b>43.67</b>	<b>1.74</b>	<b>0.31</b>	<b>17.98</b>
<b>Control Batch rearing</b>												
RSRS, Jammu	31.08.2020	08.09.2020	88.91		47.00	6:09	22:04	22.376	44.75	1.654	0.303	18.41
Avg.			<b>90.00</b>		<b>47.00</b>	<b>6:09</b>	<b>22:04</b>	<b>22.376</b>	<b>44.75</b>	<b>1.654</b>	<b>0.303</b>	<b>18.41</b>

Note: No. of DFLs distributed: 50 DFLs; No. of Farmers covered: 9; H-Hatching

**Table 7. Showing post cocoon parameters (Dry cocoon) recorded for SH<sub>6</sub>×NB<sub>4</sub>D<sub>2</sub>(2020) trial rearing at Field and Control batch during autumn (2020) at RSRS, Miran Sahib, Jammu**

Location	AFL (mtr)	Deneir	Renditta	Reelability (%)	Raw Silk (%)	Neatness
<b>Jammu Division</b>						
Lamberi (Rajouri)	728.00	2.43	2.37	75.32	30.69	93.00
Majalta(Udhampur)	764.00	2.36	3.15	80.28	31.89	95.00
Dharamkot (Kathua)	814.00	2.41	3.50	73.24	19.35	95.00
<b>Avg.</b>	<b>768.67</b>	<b>2.40</b>	<b>3.01</b>	<b>76.28</b>	<b>27.31</b>	<b>94.33</b>
<b>Himachal Pradesh</b>						
Soi (Bilaspur)	780.00	2.49	3.06	75.04	32.86	98.00
Panol (Bilaspur)	698.00	2.22	3.87	70.11	25.97	93.00
Naswal (Bilaspur)	848.00	2.35	3.33	74.68	19.05	95.00
<b>Avg.</b>	<b>775.33</b>	<b>2.35</b>	<b>3.42</b>	<b>73.28</b>	<b>25.96</b>	<b>95.33</b>
<b>Control Batch</b>						
RSRS, Jammu	879.00	2.62	3.15	88.38	33.26	93.00
<b>Overall Avg.</b>	<b>787.29</b>	<b>2.41</b>	<b>3.20</b>	<b>76.72</b>	<b>27.58</b>	<b>94.57</b>
<b>SD</b>	<b>64.41</b>	<b>0.12</b>	<b>0.46</b>	<b>5.96</b>	<b>6.21</b>	<b>1.81</b>

Note: AFL – Average filament length; SD-standard deviation

**Table 8. Showing Per cent yield gain by Experimental field trial V/s Traditional field trial during autumn season (2020)**

Particulars	Autumn season (2020) Average Yield (Kg)	Yield gain over traditional rearing (%)
<b>Jammu division</b>		
Experimental field trial	40.80	<b>67.14</b>
Traditional field trial	24.41	
<b>Himachal Pradesh</b>		
Experimental field trial	43.67	<b>44.70</b>

Traditional field trial	30.18	
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UNDER PEER REVIEW